

WHAT IS CLAIMED IS:

1. A particle identification apparatus comprising:
a flow cell for passage of fluid containing a population of labeled magnetic microspheres in a stream, said magnetic microspheres having a label providing a detectable property to said magnetic microspheres; and,
5 a magnetic measurement system, positioned adjacent to said flow cell, for measuring a magnetic moment on each labeled magnetic microsphere as it passes by said magnetic measurement system.
2. The particle identification apparatus of claim 1 wherein said magnetic measurement system includes at least two magnetic field sensors.
3. The particle identification apparatus of claim 1 wherein said magnetic measurement system includes a means of aligning said labeled magnetic microspheres within said fluid stream and at least one magnetic field sensor.
4. The particle identification apparatus of claim 1 further including a means of sorting each labeled magnetic microsphere after measurement of magnetic moment on each microsphere into collections of particles of similar magnetic moment.
5. The particle identification apparatus of claim 1 further including a means of magnetizing said population of labeled magnetic microspheres prior to passage of said labeled magnetic microspheres by an aligning means and a means of aligning said labeled magnetic microspheres within said fluid stream.
6. The particle identification apparatus of claim 2 wherein said magnetic field sensors are SQUID sensors.
7. The particle identification apparatus of claim 3 wherein said at least one magnetic field sensor is a SQUID sensor.
8. The particle identification apparatus of claim 3 wherein said means of aligning said labeled magnetic microspheres is a magnetic field.
9. The particle identification apparatus of claim 5 wherein said means of aligning said labeled magnetic microspheres is a magnetic field.

10. The particle identification apparatus of claim 3 wherein said means of magnetizing said population of labeled magnetic microspheres is a magnetic field.

11. The particle identification apparatus of claim 5 wherein said means of magnetizing said population of labeled magnetic microspheres is a magnetic field.

12. The particle identification apparatus of claim 1 further including a detection system for measuring a detectable property from each labeled magnetic microsphere.

13. The particle identification apparatus of claim 12 wherein said detectable property is selected from the group consisting of fluorescence, absorbance, reflectance and scattering.

14. The particle identification apparatus of claim 12 wherein said detection system for measuring a detectable property is a flow cytometry system and said detectable property is fluorescence.

15. A particle sorting apparatus comprising:

a chamber having an inlet for a fluid suspension of a population of magnetic microspheres to be sorted;

a magnetic field generator that produces a field gradient across said chamber for producing a force on said magnetic microspheres within said fluid suspension;

a series of collection bins positioned within the chamber for receiving magnetic microspheres with distinctly different magnetic moments as a result of movement of said magnetic microspheres resulting from the force produced on said magnetic microspheres within said fluid suspension by magnetic field gradient; and,

an outlet for fluid flow.

16. The particle sorting apparatus of claim 15 further including a means of magnetizing said population of magnetic microspheres prior to entry into said chamber.

17. The particle sorting apparatus of claim 15 wherein said means for magnetizing is a magnet having a peak field greater than the saturation magnetization of the magnetic microspheres.

18. The particle sorting apparatus of claim 15 wherein said magnetic field generator is selected from the group consisting of a magnet and a magnetic field coil positioned at a side of said chamber.

19. A kit for sorting and identifying a material within a sample, the kit comprising:

a population of magnetic microspheres each having a distinctly measurable magnetic moment, with each individual magnetic microsphere also having one or more
5 receptor agents attached thereto; and,

a population of non-magnetic microspheres, with each individual non-magnetic microsphere also having one or more receptor agents attached thereto.

20. The kit of claim 19 wherein said receptor agents further include a detectable property label thereon.

21. The kit of claim 20 wherein said detectable property label is selected from the group consisting of fluorescence, absorbance, reflectance and scattering.

22. The kit of claim 20 wherein said detectable property label is fluorescence.

23. The kit of claim 19 wherein said receptor agents further include a detectable labeled target analogue thereon.

24. The kit of claim 23 wherein said target analogue is selected from the group consisting of antigens, antibodies, peptides, proteins, nucleic acids, lipids, carbohydrates and enzymes.

25. The process of claim 19 wherein said magnetic microspheres include magnetic particles of a material selected from the group consisting of a ferromagnetic material and a superparamagnetic material.

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26. The kit of claim 19 wherein said magnetic microspheres include magnetic particles of a material selected from the group consisting of iron-cobalt, iron-platinum, and samarium-cobalt.

27. The kit of claim 19 wherein said one or more receptor agents are for a target species selected from the group consisting of antigens, antibodies, peptides, proteins, nucleic acids, lipids, carbohydrates and enzymes.

28. The kit of claim 19 wherein said magnetic microspheres include magnetic particles coated with a coating material selected from the group consisting of an organic polymeric material and glass.

29. The kit of claim 19 wherein said magnetic microspheres include magnetic particles imbedded within a material selected from the group consisting of an organic polymeric material and glass.

30. The kit of claim 19 wherein said magnetic microspheres include magnetic particles immobilized on a surface of or within a material selected from the group consisting of an organic polymeric material and glass.

31. The kit of claim 19 wherein said magnetic microspheres include the reaction product of magnetic particles coated with a material having a first reactive functionality; and, non-magnetic microspheres having a second reactive functionality, said second reactive functionality adapted for reaction with said first reactive functionality.

32. The process of claim 31 wherein said first reactive functionality is selected from the group consisting of amines, carboxylates, epoxies and one of an affinity pair, and said second reactive functionality is different from said first reactive functionality and is selected from the group consisting of amines, carboxylates, epoxies, and the other of the affinity pair.

33. A kit for sorting and identifying a material within a sample, the kit comprising at least two populations of magnetic microspheres each population having a distinctly different measurable magnetic moment.

34. The kit of claim 33 wherein magnetic microspheres within each of said at least two populations also have one or more receptor agents attached thereto.

35. The process of claim 33 wherein said magnetic microspheres include magnetic particles of a material selected from the group consisting of a ferromagnetic material and a superparamagnetic material.

36. The kit of claim 33 wherein said magnetic microspheres include magnetic particles of a material selected from the group consisting of iron-cobalt, iron-platinum, and samarium-cobalt.

37. The kit of claim 34 wherein said one or more receptor agents are for a target species selected from the group consisting of antigens, antibodies, peptides, proteins, nucleic acids, lipids, carbohydrates and enzymes.

38. The kit of claim 33 wherein said magnetic microspheres include magnetic particles coated with a coating material selected from the group consisting of an organic polymeric material and glass.

39. The kit of claim 33 wherein said magnetic microspheres include magnetic particles imbedded within a material selected from the group consisting of an organic polymeric material and glass.

40. The kit of claim 33 wherein said magnetic microspheres include magnetic particles immobilized on a surface of or within a material selected from the group consisting of an organic polymeric material and glass.

41. The kit of claim 33 wherein said magnetic microspheres include the reaction product of magnetic particles coated with a material having a first reactive functionality; and, non-magnetic microspheres having a second reactive functionality, said second reactive functionality adapted for reaction with said first reactive functionality.

42. The process of claim 41 wherein said first reactive functionality is selected from the group consisting of amines, carboxylates, epoxies and one of an affinity pair, and said second reactive functionality is different from said first reactive functionality and is selected from the group consisting of amines, carboxylates, epoxies, and the other of the affinity pair.